93 S611 Tech

DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN
OF THE BUREAU OF STANDARDS

Subscription, 25 cents a year (U. S.), 40 cents a year (Foreign). Address "Superintendent of Documents, Washington, D. C."

Washington, May, 1928—No. 133

DETROIT, MICH.

CONTENTS

Type testing of commercial airplane engines.
Twenty-first national conference on weights and measures.
Annual meeting of National Committee on Wood Utilization.
Fire tests of record-room occupancy with metal shelving.
Rate of deformation of concrete during test in compression.
Effect of brackets in reinforced concrete rigid frames.
Measurement of time of set of calcined gypsum.
Vitrification of ceramic bodies.
Light colored first coat enamels for sheet iron.
Material for filling etched lines in thermometers.
Paper-tearing tester.
Apparatus for studying flexing of tire treads.
Standard slots for automobile license-plate bracket.
Simplified-practice recommendation for range boilers confirmed.
Simplified bank checks in use.
Activities of commercial standards group.
New and revised bureau publications issued during April, 1928.
Recent articles appearing in outside publications.

TYPE TESTING OF COMMERCIAL AIRPLANE ENGINES

The air commerce regulations of the Department of Commerce provide that all airplanes considered as airworthy and permitted to engage in interstate air commerce must contain power plants approved and rated by the department. The engines first used in commercial planes were those designed and built for military purposes, and these engines are known to be safe because they have been thoroughly tested by the Army or the Navy. However, many aviation engines are now being built which are intended primarily for commercial rather than for military use, and each new type of commercial airplane engine must pass certain tests before it can be certified as airworthy by the Director of Commercial Aeronautics.

These type tests are made at the Bureau of Standards or, in exceptional cases, at the manufacturer's plant under the supervision of engineers from the bureau. Before it will be accepted for test the engine must have been run by the manufacturer for at least 25 hours, and a log of this run must be submitted with the engine. The department's present test requirements include (1) a 50-hour endurance test to be run in ten 5-hour periods, (2) full-throttle runs to determine the power developed at speeds ranging from 75 to 110 per cent of normal speed, and (3) an actual service test of the engine installed in an airplane. As the engines thus far submitted are air cooled, they have been mounted on a torque stand for the endurance test and power runs. Suitably designed propellers absorb the power and at the same time produce sufficient air blast to cool the cylinders. As soon as the necessary equipment can be installed these tests will be made in the laboratory, using

104321—28

an electric dynamometer to absorb the power and an 80-horsepower blower to supply the high-velocity air stream required to cool the engine.

The following fixed radial air-cooled airplane engines have been tested or are now under test:

Warner 7-cylinder, of Detroit, Mich.
Kinner 5-cylinder, of Glendale, Calif.
Comet 7-cylinder, of Oakland, Calif.
Szekely 3-cylinder, of Holland, Mich.

The following fixed radial air-cooled airplane engines are scheduled for test during the next two months in the order named:

Velie 5-cylinder, of Moline, Ill.
Floco 7-cylinder, of Los Angeles, Calif.
Menasco-Salmson 9-cylinder, of Beverly Hills, Calif.

Each power plant is considered on its own merits and there are no standard requirements as to weight per horsepower, fuel consumption per horsepower-hour, or oil consumption per horsepower-hour. Sound design, adequate materials, good workmanship, and reliable performance of the engine and its accessories are demanded. In accordance with Army and Navy practice, the endurance test consists of nine periods (45 hours) at rated speed and load and one period (5 hours) at 10 per cent overload.

Although the testing of commercial airplane engines has only recently been undertaken, the automotive section of the bureau has been studying the performance of aircraft power plants for over 10 years. As early as 1913 an electric dynamometer was installed at the bureau, and tests were made on two Reneault airplane engines for the Signal Corps of the United States Army. By 1917 the addition of a 400-horsepower dynamometer had provided for the laboratory testing of the most powerful aircraft engines then known, and torque stands were installed for running service and endurance tests of all sizes and types of engine. The first experimental Liberty engine was delivered at the bureau on July 3, 1917, just 21 days after its design was approved, and was tested both on the dynamometer and on the torque stand. This engine is now on exhibition at the Smithsonian Institution.

There was then designed and built the first complete laboratory for the study of aircraft engine performance under the conditions of temperature and pressure which exist at high altitudes. The altitude laboratory consists of a reinforced concrete room capable of withstanding an external pressure of a ton per square foot. This room contains refrigerating coils, a stand for mounting the engine, connections for supplying metered quantities of air, fuel, oil, and water to the engine, for taking away the exhaust gases, and for measuring the temperatures and pressures in and about the engine. The engine, mounted in the chamber, is connected, by means of a shaft carried through the wall, to an electric dynamometer for controlling the load and measuring the power developed. All necessary measurements, in fact, are made by means of instruments outside the test room. With this equipment the pressure at the intake and the exhaust, as well as the temperature, pressure, and humidity of the air entering the carburetor and surrounding the engine are controlled. The engine can thus be run at the ground under the precise conditions which might be encountered at any altitude up to 30,000 feet, and all features of its behavior under these conditions are accurately measured. Before this equipment was available tests of the Liberty engine and of superchargers were made on the top of Pikes Peak, although the equipment which could be transported by truck to the altitude of 14,000 feet permitted only the crudest kind of test.

In the past 10 years all the important American-made water-cooled engines and several foreign makes have been subjected to comprehensive tests in the altitude laboratory, and in many cases important defects have been discovered and remedied because of the ability to make very accurate measurements under the extreme conditions of pressure and temperature encountered in flight. Tests of the Liberty 12 engine and of the Curtiss D–12 engine under ideal supercharging conditions (that is, with air at sea-level pressure supplied to the carburetor while the pressure at the exhaust and around

the engine was reduced to correspond with that existing at various altitudes) were undertaken a few years ago at the request of the National Advisory Committee for Aeronautics. These tests and tests of the Curtiss D–12 engine equipped with a geared centrifugal supercharger which were made for the United States Army Air Corps showed the need of additional exhauster and air cooling capacity. Accordingly, larger vacuum pumps and a complete new cooling system have been installed.

There is needed at the present time a corresponding altitude laboratory for the accurate testing of large air-cooled aircraft engines under the conditions encountered in flight. Such a laboratory will differ from the present installation chiefly in having provision within the evacuated engine chamber for the circulation of air at the high velocity required for efficient engine cooling.

TWENTY-FIRST NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

Although the Bureau of Standards has no regulatory power, it has played an important part in the movement for greater uniformity in weights and measures laws and regulations throughout the United States. One of the ways in which this has been accomplished is by holding each year at the bureau a national conference composed of weights and measures officials from all over the country, manufacturers, and others interested in weights and measures matters. After this conference papers are presented dealing with every phase of weights and measures enforcement, practical solutions to common problems are worked out, and reports of progress are presented. The conference is always well attended, although attendance is entirely voluntary. However, the majority of the State governments have long recognized the desirability of being represented, and the same applies to manufacturers of weighing and measuring appliances.

The twenty-first conference will be held on May 22 to 25 The tentative program, which contains much of interest, is as follows:

Tuesday, May 22

Morning Session, 10 a. m.

NOTE.—Sessions on this day will be held at the Bureau of Standards.

Registration of delegates and guests.

Address of the president of the conference, Dr. George K. Burgess, Director, Bureau of Standards.

Reports of State delegates.

Reports of representatives of State associations of weights and measures officials.

Luncheon at the bureau

Afternoon Session, 2 p. m.

Report of the secretary of the conference.

Bureau of Standards investigation on transmission drive for taximeters; Ralph W. Smith, Bureau of Standards.

A new scale-testing device; Warren Hem, engineer, Toledo Scale Co.

Installation of Bureau of Standards master scale; H. M. Roeser, Bureau of Standards.

New equipment for testing heavy-capacity scales in New Jersey; Joseph G. Rogers, assistant superintendent, Department of Weights and Measures, State of New Jersey.

Proposed amendment to section 21a of model State law.

Wednesday, May 23

Morning Session, 10 a. m.

NOTE.—This session of the conference will be held at the House Office Building, adjacent to the Capitol.

Hearing on H. R. 7208, "A bill to regulate and control the manufacture, sale, and use of weights and measures and weighing and measuring devices for use or used in trade and commerce, and for other purposes."

Acting under instructions from the Twentieth National Conference on Weights and Measures, a special conference committee, appointed for this purpose, secured the introduction of this bill into the present Congress.

Afternoon Session, 2 p. m.

NOTE.—This session of the conference will be held in the tenth-floor ballroom of the Raleigh Hotel, Pennsylvania Avenue at Twelfth Street.

Supervision of gas and electric meters in Texas; W. T. Henrichson, meter inspector, division of weights and measures, State of Texas.

Some comments on cooperation among weights and measures officials; J. H. Meek, director, division of markets, State of Virginia.

Promotion of interest in weights and measures supervision by essay contests among school children; James J. Dawson, inspector of standards, State of Massachusetts.

A periodical on weights and measures by the sealers' association; A. W. Corwin, sealer of weights and measures, County of Allegany, New York, and editor, Weights and and Measures News.

Report of special committee on constitution and by-laws.

General consideration of subjects of interest and questions brought up for discussion by city and county officials.

At this time officials should bring before the conference for consideration all subjects of interest to them not elsewhere listed on the program.

All officials are urged to participate in these discussions in order to make them of maximum value.

Appointment of committees.

Thursday, May 24

Morning Session, 10 a. m.

NOTE.—Sessions on this day will be held at the Bureau of Standards.

Weights and measures aspects of chain-store operation; A representative of The Great Atlantic and Pacific Tea Co.

Report of Committee on Specifications and Tolerances on specifications and tolerances for grease-dispensing devices.

Address, Hon. Herbert Hoover, Secretary of Commerce.

The business man and the weights and measures official; Edward L. Greene, general manager, National Better Business Bureau (Inc.).

The development of industry; A. Bousfield, chief engineer, E. & T. Fairbanks & Co.

Official photograph.

Luncheon at the bureau

Afternoon Session, 2 p. m.

Testing of gasoline meters in the field; William Foster, sealer of weights and measures, City of Springfield, Mass.; Theo. A Seraphin, district supervisor of weights and measures, city and county of Philadelphia, Pa.; John H. Stephenson, sealer of weights and measures, City of Rochester, N. Y.

Testing of gasoline meters in the factory (several manufacturers of gasoline meters will speak on this subject).

Report of Committee on Specifications and Tolerances on the specifications and tolerances for liquid-measuring devices tentatively adopted in 1927.

Report of Committee on Specifications and Tolerances on the tentative specifications and tolerances for lubricating-oil bottles.

Friday, May 25

Morning Session, 9.30 a. m.

NOTE.—This session of the conference will be held in the tenth-floor ballroom of the Raleigh Hotel, Pennsylvania Avenue at Twelfth Street.

Report of Committee on Specifications and Tolerances on minor changes in codes of specifications and tolerances formerly adopted.

Flood conditions as affecting weights and measures officials in New England; H. N. Davis, deputy commissioner of weights and measures, State of Vermont.

Citation by weights and measures officials of important court decisions in their jurisdictions.

Notes on digest of weights and measures cases; William Parry, Bureau of Standards.

Report of committee on nominations and election of officers.

Report of committee on resolutions.

Report of treasurer.

Unfinished business.

New business.

Suggestions for program of twenty-second conference.

12.30 p. m. Reception by the President of the United States.

(Arrangements for this number are in progress, and it is anticipated that the delegates and guests will be given the opportunity at this time to pay their respects to President Coolidge at the White House.)

ANNUAL MEETING OF NATIONAL COMMITTEE ON WOOD UTILIZATION

The third annual meeting of the National Committee on Wood Utilization of the Department of Commerce was opened on the afternoon of May 4 by Secretary Hoover, chairman of the committee. Accomplishments during the past two years and what the committee has done to promote economy in the use of wood as a means of advancing commercial reforestation, was the keynote of the discussions during the two half-day sessions on May 3 and 4.

Representatives of the various branches of the forest industries, distributors, and consumers of forest products from every section of the United States attended. Brief talks were given describing the interest of each group in the committee's work. Grade marking—the marking of every piece of lumber at the producing mills with appropriate symbols denoting quality or grade—was one of the most important questions considered.

Director Axel H. Oxholm presented his annual report for the past year at the first session, while W. B. Greeley, Chief of the United States Forest Service and vice chairman of the committee, opened and presided at the second session.

Some of the interesting points brought out by the various speakers are as follows:

A. C. Goodyear, of Buffalo, president of the Great Southern Lumber Co., pointed out that only by complete utilization of the tree can reforestation be commercially successful, and this implies large investment in plants and forest land.

In his opinion, the small owner of timber, whose investment in plant and logging equipment is small, whose needs of money are immediate, and whose methods of production are comparatively crude, will never be greatly interested in timber growing, because "the element of time alone would make such a project to such a man impracticable. It is only to the large owner with a large plant investment, the potential value of which will otherwise become extinguished, that reforestation can possibly appeal."

Mr. Goodyear called attention to the methods adopted in Sweden, where growers count upon a full utilization of their property as the best assurance for profitable reforestation. They do not count upon the sawmill alone. They join to it the paper mill, charcoal burning, and by-products, and their experience has been that in periods when the lumber business was unprofitable their paper production frequently carried them over a threatened disaster. In Mr. Goodyear's opinion, southern reforestation is likely to follow much the same course, since only by complete utilization can reforestation be commercially feasible.

R. B. Robertson, of Canton, N. C., president of the Champion Fiber Co., discussed the many difficulties which confront the plant endeavoring completely to utilize the raw material. He emphasized the fact that unless wood can be converted at a profit it is better to waste the raw material than to aggravate the wastage by untimely capital investment. In other words, there must be a profitable market for the commodities produced. The fact that forest products are perishable and that coordinated use calls for simultaneous, not successive, development, should not be forgotten, since real conservation of our forest resources will not come until conservation becomes profitable. However, every step toward profit through by-product utilization brings closer the day of its realization.

D. H. Sawyer, secretary of the Associated General Contractors of America, stressed the importance of grade marking all lumber to indicate its quality. Of particular value, in his opinion, is the publication now being prepared by the committee bearing upon the proper use of wood in building and construction.

The group which Mr. Sawyer represents does $2,500,000,000 worth of construction work a year, covering practically all types of major construction activities. This group has been interested from the beginning in the opportunities which the committee offers to effect improvements in the use of wood in the construction field, and feels that accomplishments to date have justified their continued interest in its work.

Wood and its proper use in construction have been pretty generally taken for granted, according to Mr. Sawyer. He stated that we are using wood to-day about as it was used 300 years ago, and we are doing this in the face of very different conditions in the lumber industry. While there is much scattered information on the use of wood in construction, the mere fact that it is scattered forms a barrier to its use.

This is why the contractors have been particularly interested in the preparation by the committee of a volume on the use of wood which will be comprehensive and up to date. As it is being prepared by experts who know the needs of the building industry, it will be an authoritative volume placing at the disposal of architects, engineers, and contractors

facts that will enable them to use wood more efficiently. A wiser use of wood will tend to reduce construction costs and result in dollars-and-cents savings to the average citizen.

Greater efficiency in building and less wasteful use of building materials as a means of preserving high living standards were advocated by N. Max Dunning, architect, of Chicago.

"The architect, as a professional man with a responsibility to the public, is vitally interested in the work being accomplished by the national committee," according to Mr. Dunning. "If present high standards of living are to be maintained and increased, the burden of the higher wage and better working conditions must be offset by a greater application of scientific methods in building operations and to a more intelligent and less wasteful use of the materials entering into buildings. Wood, from many considerations, is the most important of these materials, and without question the material where waste in the past has been the most extravagant.

"The architect is primarily interested in the use of lumber in buildings and realizes that great economies can be effected by improvements in methods of framing that will develop the full strength of lumber sections and secure permanence and durability of construction; that for many purposes short lengths of lumber can be used as well as long; that, with the perfection of modern joining machinery, blocks and odd sizes can be worked up for floors, wainscoting, and for other purposes, thus eliminating waste and utilizing far greater proportions of the log than are commercially possible now."

William F. Chew, managing director of the Builders Exchange of Baltimore, pointed out that builders of the United States sponsor the universal grade marking of every piece of lumber to show its quality.

Mr. Chew declared that foremost among the interests of the exchanges is the desire to effect improvement in the building industries, and one of the most important problems in this field has to do with the use of building materials. The builders are glad to do everything possible to stimulate a wider demand for short-length and end-matched lumber. The group represented by Mr. Chew, composed of 50 local builders' exchanges with a total membership of 15,000, is unanimously in favor of grade marking and the development of practices in the lumber industry which will insure the receipt of better and well-seasoned lumber.

How the home builder can have a better home at less cost by following some of the economy recommendations of the national committee was outlined by W. S. Quinter, Washington banker.

"The use of grade-marked lumber alone would justify a building association to make a larger loan on a home, because this system of marking each piece of lumber with a symbol denoting its quality gives assurance of good construction material," said Mr. Quinter.

The United States League of Local Building and Loan Associations is composed of local associations from all of the United States—over 12,000 in number—with a combined membership of over 11,500,000 savers and home owners and over $7,000,000,000 in assets. These associations made mortgage loans in excess of $2,000,000,000 during 1927, providing funds for the buying and building of 600,000 homes, or about 1,600 a day.

In Mr. Quinter's opinion, the biggest and most important work yet undertaken by the committee is the movement for grade marking. While the appraisers for building and loan associations are usually men who have had experience in both the building and selling of homes, they are not lumbermen or even builders, and grade marks would be of very great assistance to them, giving them the assurance that the grade of material called for by the specifications was actually going into the construction of the home. Home owners, who in most instances are building for the first time, would be even more anxious to see that first-grade lumber is being used.

An association would be justified in making a larger loan where grade-

marked lumber was to be used throughout, giving the assurance that the home was to be constructed of the highest class of material.

FIRE TESTS OF RECORD ROOM OCCUPANCY WITH METAL SHELVING

As a means of obtaining information on the severity of fires in buildings, a number of burning-out tests have been made at the Bureau of Standards in one-story fire-resistive buildings constructed for this purpose, the contents simulating light commercial or office occupancy. Notes relative to some of the later tests were published in Technical News Bulletins Nos. 114 and 116 (October and December, 1926). As a result of these tests it was found that there should be no difficulty in constructing buildings to resist such fires as ordinarily occur in occupancies employing mainly desks and filing cabinets, in which the weight of combustible materials (including the wood top floor present in some of the tests) amounts to from 10 to 20 lbs./ft.^{2} of room area. With larger concentrations of combustible materials, such as in the record and library rooms often found in office buildings, fires of considerably greater severity can occur, as was shown in several tests with records on wood shelving giving total combustible contents of 49 to 59 lbs./ft.^{2} of floor area. This condition requires heavier protection than the rest of the building, and inasmuch as these concentrations may be placed anywhere within the building the general design would have to take them into account. The tests with metal shelving, which conclude the work with office occupancy, were undertaken to determine to what extent the fire severity from these concentrations can be reduced.

In the first tests metal shelving representative of several general types was used, nearly one-half of the records being on "skeleton" type shelves having no partitions or backs. Others had partitions but no backs or backs without partitions, and one 29-foot single row had both partitions and backs with doors on two 3-foot bays. All shelving was 8 feet 3 inches high with five or six shelves, the weight of records in the 15 by 29 foot room being 21,330 pounds in all of these tests or about 49 lbs./ft.^{2} of floor area. No wood top floor was present in any of the tests with record-room occupancy. The first test was started with a waste-paper basket fire in front of a single-depth bay open at the front but with metal back and partitions. The window shutters were opened to give the air supply deemed most favorable for fire spread, but no general fire condition resulted, the fire when put out at 7 hours 20 minutes being confined to two 3-foot wide bays with some charred or glowing papers in a cupboard adjacent to one of them.

The affected paper was replaced and two fires were started in piles of waste paper on the floor, one in front of shelving similar to that in the first trial and the other in front of a double-depth "skeleton" row. The fire progressed more rapidly than in the first test, particularly in the open shelving, and at the end of 1½ hours the whole room was involved. Collapse of skeleton-type shelving began at this time and eventually involved all of the shelving that did not have partitions. All combustible contents of the room were completely consumed, the equivalent duration of the fire being, however, less by 25 to 30 per cent than obtained in previous tests with wood shelving and an equal amount of records.

The room was fitted with new shelving, mainly of the backed and partitioned type, with doors every third bay. Three double bays of well-braced skeleton-type shelving were also included. One test with a slow start for the fire, made in a manner similar to that of the first test described above, progressed laterally through a 3-foot wide cupboard section and another 3-foot-wide section with open front in 20 hours, but no general fire spread resulted. A second fire in front of a double-depth open front, backed, and partitioned bay spread through a closed front section on each side and involved the whole 18-foot wide stack in about 9½ hours. In this test

the window shutters were kept at the lowest opening, and while this retarded the fire at some stages it enabled room temperatures to be built up high enough to cause general fire spread at 13½ hours.

The room was reloaded for tests with "exposure" start for the fire. This condition was approximated by starting a fire in oil-soaked wood kindling filling a grate about 3 feet in diameter and 7 feet high. A shield around it was withdrawn when the kindling was burning freely, the resulting air temperatures in most portions of the room being about the ignition point of paper for 10 to 15 minutes. While fires started at many points, they did not progress and at two hours the average room temperature was below 100° C. Similar results were obtained in a second exposure start. After one hour the window shutters were closed to their lowest opening and the fires which had started in various portions of the room allowed to go on until air temperatures high enough to cause general fire spread were built up. This required about four hours, the fire in the skeleton bays being mainly responsible for the relatively rapid temperature rise. The contents of the whole room were soon involved, the fire being quite intense but of shorter duration than in previous tests with record room occupancy. No collapse of shelving supports from fire exposure occurred during this test, most of the contents remaining on the shelves until consumed. The equivalent duration of the fire, while considerably above that found in any of the tests with the desks and filing cabinets referred to above, was lower by 35 to 40 per cent than obtained in comparable tests with an equal amount of records on wood shelving.

The results of all tests with office occupancy are being prepared for publication as a paper in the bureau's technologic series. An outline of the tests and summary of results was given in a paper before the annual meeting of the Building Officials Conference in Detroit on April 25.

RATE OF DEFORMATION OF CONCRETE DURING TEST IN COMPRESSION

The rate of deformation of materials during strength test affects the strength values that are obtained, an increase in rate of deformation resulting, in general, in an increase in strength. This characteristic is apparently connected with the flow or the rate at which the particles of the body will readjust themselves to new positions during strain and is an entirely different phenomenon from the influence of the inertia of the mass of a structure which will permit a much higher instantaneous loading, such as will result from an explosion, than will be statically sustained. Tests by Abrams, described in Proceedings of the American Society for Testing Materials, Vol. XVIII, 1917, p. 364, have shown the relation between the strength of various concrete mixes and the velocity of the testing machine head, the actual deformation of the concrete itself not being given.

In connection with the tests on the Santeetlah Dam cylinders, described in Technical News Bulletin No. 129 (January, 1928), several of the 6-inch cylinders were tested with plaster of Paris caps on both ends, and several were tested without capping, the ends having been previously ground to a true plane surface. The idle speed of the testing heads of the machines was 0.05 inch per minute, generally adopted as standard, and the requirement of A. S. T. M. specification C39–25. These latter machines are equipped, in accordance with the foregoing specification, with a spherical bearing block for the top of the specimen.

The results obtained are tabulated below. Although not shown in the table, the rate of deformation is very slow at first, then increases in value, becoming practically constant and remaining so throughout the greater part of the test. This latter rate has been given in the table. Although it is to be expected that the rate of deformation of the concrete will be less than the speed of the head when the cylinder is capped on

both ends with plaster of Paris, the large difference in speeds is surprising, moreover, in view of the difference in speeds being maintained through the greater part of the test. The speed difference of head and rate of deformation of the concrete cylinder without caps is even more unexpected.

Rate of deformation and testing machine head speeds

Capacity of machine (in pounds)	Cylinder diameter	Speed of testing machine head	Rate of compression of specimen
	In.	*In./min.*	*In./ft./min.*
600,000	18	[1] 0.050	[1] 0.0019
			[2] .0021
	12	[1] .050	[2] .0028
			[3] .0035
		[1] .055	
		.038	[2] .0038
200,000	6	.044	[3] .0036
		.018	[3] .0061
		.021	[3] .0074
		.022	[3] .0070

[1] Idle speeds.
[2] Specimens capped with plaster of Paris on both ends.
[3] No cap; cylinder ground on both ends.

EFFECT OF BRACKETS IN REINFORCED CONCRETE RIGID FRAMES

This investigation was begun by the Emergency Fleet Corporation of the United States Shipping Board during the World War in order to find out how much saving in weight of the transverse frames of concrete ships could be effected by introducing brackets or haunches at the intersections of the members of the frames. At the close of the war the test data were transferred to the Bureau of Standards and a technologic paper giving the results of this investigation is now in press.

Nine frames were tested. All were inverted U frames hinged at the lower ends of the vertical legs. All had a span of 14 feet and a height of 7 feet. Three frames with no brackets were tested, and two each with brackets 12, 24, and 42 inches long. The length of brackets is measured from the inner face of the vertical leg (or end post) toward the center of the frame to the end of the bracket. The effect of brackets is sometimes considered as a shortening of the span. This investigation showed that this shortening is not constant for a given size of bracket, but varies also with the ratio of height to span of the frame.

To determine the moments in these frames by exact methods is complicated and tedious, but it was found that for a uniform load the moment at the center of the horizontal member is given closely enough for most design problems by a simple empirical equation based on an analysis of the frames.

For the analysis of closed frames or inverted U frames with legs fixed at the bottom it is shown that the vertical distance from the horizontal member to the point of inflection of the leg may be used in the same equation instead of the height of the freely supported U frames. The error in the resulting moment is slight. The paper gives a diagram from which the position of the point of inflection for a large variety of frames may be estimated easily.

For other than uniform and centrally concentrated load an analogous method of determining moments through the use of influence lines for the horizontal reaction is developed.

The conclusion is drawn that the results of the tests confirm the theoretical deduction that brackets can be used to effect a considerable saving of material and of dead weight in a structure. The bracket eliminates the high local stress found in the sharp corners of a frame; it produces a more uniform variation in stress along a frame, thus minimizing the tendency toward the formation of cracks; and it reduces bond and shearing stresses at the corners of the frame. Further, by a careful choice of brackets, the bending moment may be varied considerably, and thus a proper balance may be secured between the stresses in regions of positive and those of negative moments.

MEASUREMENT OF TIME OF SET OF CALCINED GYPSUM

During the course of a recent investigation dealing with the effect of various

substances on the time of set of calcined gypsum it became necessary to develop a method for measuring the time of set which would be accurate, dependable, and capable of indicating very slight differences in time of set of different samples.

The Vicat needle penetration test commonly used for measuring this property of calcined gypsum was found not to be of the degree of sensitivity desired. Furthermore, this method gives an empirical value which gives no indication as to the length of time over which the reaction between calcium sulphate hemihydrate and water to form gypsum takes place. H. A. Neville (J. Phys. Chem., Vol. 30, pp. 1037–1042) has shown that the time required for a setting mass of calcined gypsum and water to reach a maximum temperature is a measure of the time required for completion of the reaction:

$$CaSO_4.1/2H_2O+1\tfrac{1}{2}H_2O=CaSO_4.2H_2O$$

Neville found his point of maximum temperature by inserting a thermometer in a sample of the mix which was contained in a paraffined cup. The cup in turn was insulated to reduce heat losses from conduction and radiation. However, in order that time-temperature rise data may be used to give reliable results on time of set it is necessary to measure temperature rise on samples which are kept as nearly as possible under adiabatic conditions; that is, there must be no appreciable loss of heat from the sample to the surroundings.

Some preliminary tests have been made on samples of several sizes, insulated against loss of heat in various manners. All mixes were prepared from the same type of calcined gypsum, were mixed with similar proportions of water, and were initially at the same temperature. Temperatures were measured with thermometers graduated to $\frac{1}{10}$° C., inserted directly in the mix. Sample 1 was a 25 g sample of C. P. calcium sulphate hemihydrate, mixed with 25 ml water, placed in a small paraffin cup, the whole being well insulated with fibered asbestos. Sample 2 was of the same size as 1 but was placed in a 1-pint capacity thermos bottle during the test. Sample 3 was prepared from 300 g hemihydrate and 300 ml water, the whole being mixed in a large paraffin cup. A thermometer was inserted in the center of the mix, and the cup was placed in a 1-pint capacity corked thermos bottle, which was filled with this amount of material.

The data indicated that samples 1, 2, and 3 reached maximum temperatures at 26, 26½, and 38 minutes, respectively. It is evident that for samples 1 and 2 the loss of heat became greater at 26 minutes than the gain of heat due to the crystallization of gypsum, therefore, the temperature of the mass decreased before the reaction was complete. Adiabatic conditions were not realized with samples 1 and 2, as their cooling curves clearly indicated. Sample 3, being of much greater mass, lost heat to its surroundings so slowly as to have practically no effect on temperature rise due to crystallization. Under ideal adiabatic conditions the temperature of a setting mass of gypsum would rise to a maximum which would be maintained indefinitely. For sample 3 the temperature drop after this maximum point is reached was 0.0135° C. per minute, although the temperature of the gypsum was about 20° C. above that of the atmosphere, or a sufficiently close approximation to adiabatic conditions. It is believed that such procedure could be used as a measure of time of set.

VITRIFICATION OF CERAMIC BODIES

At the Columbus branch of the bureau an investigation of the boundary of the field of mullite in the K_2O–Al_2O_3–SiO_2 system is being made. In so far as possible, minerals are being used in making the melts.

The general procedure has been to mix the proper proportions of minerals with dextrin, making a paste which is forced through a glass tube drawn down at one end to about 2 mm diameter. This "spaghetti" is then melted in an oxygas flame and the beads quenched in water or mercury. The melt is examined microscopically for a crystal phase and the index of the glass measured.

The results are then plotted on a three-component diagram.

Melts containing varying amounts of orthoclase, kaolin, and flint (silica) were first made and examined. Mullite crystals were found to occur in melts containing at least 30 per cent kaolin, those with less being composed almost entirely of glass. There is an almost constant variation in the indices of the glasses ranging from 1.48 with 10 per cent kaolin to 1.54 with 90 per cent. The amount of mullite crystals increases with the index of the glass. The crystals occur as fibers showing position elongation; indices are $\omega=1.64$, $\epsilon=1.66$.

Leucite-kaolin melts show practically the same results as do orthoclase-kaolin melts. Mullite and alumina have been used with orthoclase and leucite. The primary mullite crystals appear in all the melts containing up to 90 per cent mullite under the conditions of experimenting. When alumina is introduced, the mullite crystals appear in melts containing as much as 50 per cent. The appearance of beta corundum near the alumina end of the diagram has been very interesting.

An effort is now being made to make a composition of material corresponding to kaliophilite, $K_2O.Al_2O_3.2SiO_2$, to be used with kaolin, mullite, and alumina in locating the extent of the mullite field in that direction, though as yet the extreme volatility and solubility of potash have prevented success. No detailed work has been done along the boundary lines, as a reconnaissance of the whole field is first being made. Temporary factors as well as volatilization will probably have to be taken into account in later work.

LIGHT-COLORED FIRST-COAT ENAMELS FOR SHEET IRON

In an item on this subject which appeared in Technical News Bulletin No. 127 (November, 1927) there were given some results of preliminary adhesiveness tests, showing the effects of treating the metal in various ways before applying the enamel. Since that time effort has been continued to improve the strength of the enamel metal bond by treating the metal, and some treatments have been developed which, to cause failure, require loads more than 50 per cent greater than any reported in the previous item.

Previously reported results showed that adherence was improved by allowing a thin coating of oxide to form over the iron in a furnace before applying the enamel. The application of different cobalt compounds directly to the metal also proved beneficial in varying degrees. Accordingly, the combination of both treatments was tried and with better results than were obtained by either treatment alone. Best results were obtained in the application of the cobalt salts when the metal was dipped in a hot solution and allowed to remain there until it reached approximately the temperature of the bath. Cobalt nitrate appeared to be about the most desirable of the cobalt salts to apply to the iron because it decomposed on the iron with a comparatively gentle heat treatment, and the decomposition product (presumably essentially cobalt oxide) had but little tendency to float in the applied slip and stain the enamel.

The treatment of the metal selected as a standard for a series of tests which will involve a variety of enamel compositions is as follows: The cleaned metal is dipped in a 5 per cent solution of cobalt nitrate at about 90° C. (approximately 195° F.) and allowed to remain until the metal is hot. On removal from the solution the piece is whirled and touched on a flat cloth to remove any excess solution from the edges. It quickly dries and is heated in a furnace at 300° C. (about 570° F.) for five minutes. The cobalt nitrate appears to decompose at this temperature when in contact with the iron, and the iron simultaneously acquires a light coating of the oxide. The light-colored enamel is then applied to the treated metal.

Adhesiveness test values have been obtained with the above and other treatments which appear quite promising when compared to those obtained with standard cobalt ground coats.

MATERIAL FOR FILLING ETCHED LINES IN THERMOMETERS

It is a matter of common experience that the materials ordinarily used for coloring the lines and figures on etched-stem thermometers are not permanent under all conditions of use. The color in the lines of chemical thermometers burns out at high temperatures or at lower temperatures is removed by the action of fluids in which the thermometers are immersed. For clinical thermometers no material has been available which would not be removed by some of the antiseptic solutions ordinarily used.

A new material developed by Paul T. Hannen and H. D. Bruce, of the Bureau of Standards, is much superior in durability to those now in use. It consists of a mixture of water glass and finely divided manganese dioxide, which is applied as a paste. A thermometer treated with this material retains the color even when heated to 500° C. and can be used in hot oil, water, or steam without injuriously affecting the visibility of the lines. Clinical thermometers may be treated with any of the common antiseptic solutions without removing this coloring material. The ability of the material to resist attack by acids and alkalies has not been thoroughly tested, but the indications are that it is not entirely resistive to these.

Pigments, other than manganese dioxide, may be used with the water glass to produce other colors.

Application has been made for a patent, dedicated to the public, covering the material and its application. A description of the material and directions for its use are given in a letter circular, which may be obtained on application to the Bureau of Standards.

PAPER-TEARING TESTER

An article published in Paper Trade Journal (March 29, 1928) gives the results of a study of the Elmendorf tearing tester. An investigation, involving a comparison of the properties of different roofing felts, called for the use of a tearing tester of much greater capacity than any commercially available. It was desirable to double the capacity of the tester, in such a manner as to permit the use of the existing scale. Likewise, it was considered important to introduce as little change as possible in the construction of the instrument. In order to secure the necessary data for the altered design, it was necessary first to derive an adequate calibration formula for the tester. The derivation and use of this formula are given in some detail in the article, since the literature does not afford an adequate means of calibrating the scale on the instrument. A simple procedure for periodic adjustments is also given. By means of a formula analogous to the one derived an auxiliary weight was designed which can be quickly attached to or removed from the tester and which just doubles the values of the scale readings without necessitating any other alteration in the instrument. However, a few changes in the design of the instrument itself which might improve its performance are also noted.

APPARATUS FOR STUDYING FLEXING OF TIRE TREADS

In a recent press notice mention was made of an apparatus built at the bureau for observing (through a heavy plate glass) the flexing of tire treads. A technologic paper has been prepared and is now in press which describes in detail the results of tests made with this apparatus, as well as the results obtained by another method which proved to be a satisfactory one for obtaining similar data. With this latter method a piece of sheet metal is given a thin coating of soft wax and is then sprinkled sparingly with grains of carborundum. A tire under the desired load and air pressure is rolled over the waxed plate, the carborundum grains stick to the tire and each traces on the plate the movement of the particular point on the tire to which it happens to stick. Some very interesting information concerning tread movements was obtained in this way, and the method has the advantage that it can be carried out with very little equipment.

STANDARD SLOTS FOR AUTOMOBILE LICENSE-PLATE BRACKET

Automobile license plates for 1928 in 48 States, the District of Columbia, Porto Rico, Alaska, Hawaii, and the

Philippine Islands now conform to the standard plate bracket slots developed by the Society of Automotive Engineers. This is the first year in which all plates are in conformity with the standard.

Several years ago the assistance of the division of simplified practice was requested by the Society of Automotive Engineers in developing a standard of this kind. The division took up the matter with the several State motor vehicle authorities, urging them to recognize this standard, inasmuch as there was a great variety in plate punchings at that time and relatively few of them matched up with the standard plate bracket slots developed by the Society of Automotive Engineers.

At the time the subject was presented to the division consideration was also given to the possibilities for standardizing the size of plate symbols, the gauges of metal, size of plates, code of numbering, location of plates on cars, illumination of the license plates, and the coordination of color selection.

Practically all cars now come through production equipped with standard plate-mounting brackets, so it is no longer necessary to file, punch, drill, or otherwise mutilate plates in order that they will fit, eliminating much of the annual annoyance, irritation, and bother to motorists when changing plates.

SIMPLIFIED PRACTICE RECOMMENDATION FOR RANGE BOILERS CONFIRMED

A joint meeting on April 18, 1928, in New York City, of representative manufacturers, distributors, and organized users reconsidered Simplified Practice Recommendation No. 8, Range Boilers and Expansion Tanks.

Suggestions to the standing committee for the revision of this recommendation, so as to include range boilers with four tappings, received detailed discussion. The recommendation was reaffirmed for another year, with the proviso that the following paragraph be included in the reprinted copies of the recommendation:

The demand for range boilers with four side tappings being insufficient at this time to be recognized as standard, and the conference desiring to take cognizance of the resolution of the National Association of Master Plumbers, the manufacturers will recognize orders for range boilers with four side tappings, and when so supplied the side tappings shall be placed in line at the side at 6, 18, and 26 inches from the bottom and 6 inches from the top.

The original recommendation provided for two side tappings, one 6 inches from the top and one 6 inches from the bottom. The average degree of adherence to range boilers is 96.37 per cent and to expansion tanks 99.37 per cent.

SIMPLIFIED BANK CHECKS IN USE

Eighty-five per cent of bank checks now issued comply with the simplified form promulgated under the auspices of the Division of Simplified Practice, E. R. Preston, president of the American Bankers Association, said recently in discussing the simplification program and the savings resulting from adherence to it. The simplified check replaces the heterogeneous shapes and sizes in use prior to its development. Mr. Preston stated that the universal adoption of simplified checks will mean a saving of at least $20,000,000 a year in the conduct of the Nation's business.

ACTIVITIES OF COMMERCIAL STANDARDS GROUP

Tires.—The project to establish a simplified line for balloon tire sizes has been given greater impetus. As a result of cooperative action between the manufacturers of automobile tires, the Society of Automotive Engineers, the Rubber Association of America, and the Tire and Rim Association, a tentative simplified practice recommendation has been drafted, which would reduce the variety of balloon tire sizes from 40 to 17. A meeting held in Detroit of representatives of tire, rim, and car manufacturers, the National Automobile Chamber of Commerce, the Rubber Association of America, the Society of Automotive Engineers, and the Tire and Rim Association approved the simplified list, which will apply only to 1929 and future equipment, and will not concern itself with present rolling equipment.

Loading platforms and lift trucks.—This project was discussed at the meeting of the materials handling division of

the American Society of Mechanical Engineers in Philadelphia last month. A representative of the division of simplified practice addressed the meeting on this subject, and afterward met with various groups, including shippers, railroad officials, and manufacturers of equipment, all of whom heartily indorsed the proposal of establishing national dimensions of platforms, hand-lift trucks, electric-lift trucks, and accessory equipment.

At a meeting of the Electric Lift Truck Manufacturers' Association, held last month, the project was formally indorsed by the association and a committee of three appointed to cooperate with the division of simplified practice in developing the matter. The manufacturers of hand-lift trucks are proposing similar action to be taken by their association at its next meeting.

The division of simplified practice expects to arrange two preliminary conferences in the near future, the first to include large shippers who are already using the truck and platform system of handling materials, or who expect to use it if the establishment of national standards for equipment assures interchangeability. Railway traffic and stores officials are also expected to attend this conference. A second preliminary conference, to include the manufacturers of electric and hand lift trucks and of platforms, together with railway officials, will be held as soon as possible after the first conference, for the purpose of formulating tentative standards of dimensions for this equipment. Data will be available by that time on all existing sizes now in regular production.

Hack-saw Blades.—A general conference of manufacturers, distributors, and organized users, held at the Department of Commerce April 12, approved a simplified practice recommendation for standard tungsten and carbon hack-saw blades. The conference set July 1, 1928, as the date on which the recommendation shall become effective for new production, and January 1, 1929, as the effective date for clearing current stocks. The recommendation as adopted represents a reduction of approximately 75 per cent in variety. It does not apply to what is known as high-speed blades and is limited to standard tungsten and carbon blades.

Hospital Plumbing Fixtures.—At a recent preliminary conference of manufacturers a recommended list of over-all dimensions was worked out for solid porcelain and vitreous china plumbing fixtures for hospital use. It was the sense of the meeting that enameled-iron fixtures be included in the recommendation to the hospital authorities. A tentative recommendation is to be worked out in the near future at a joint meeting of the plumbing-fixture manufacturers and the standardization and simplification committee of the American Hospital Association.

Buffing Wheels.—At the preliminary conference of the simplified practice committee it was unanimously voted that a variety survey should be made to ascertain the facts upon which to base a tentative simplified practice recommendation for presentation to the industry. As soon as a satisfactory questionnaire has been prepared it is the intention of the committee to have the division of simplified practice mail out a copy to each manufacturer, asking for specific data from which to prepare a composite report showing the present practice in the industry.

Auto Bumpers Standardization.—What causes the most traffic tie-ups? While many motorists might suggest starter trouble, lack of gas, or overheating, a recent experience in Washington in a typical instance of heavy traffic shows that locked bumpers cause the most difficulty. This brings out the fact that there is a pressing need for standardization of heights of automobile bumpers as attached to cars. Seldom will two different sets meet face to face. They invariably "lock." A movement is under way looking to this end. In drafting a proposed uniform motor-coach code, prepared by a special committee representing the National Automobile

Chamber of Commerce, the Connecticut Public Utilities Commisison, the Society of Automotive Engineers, the Motor Vehicle Conference Committee, and the publication, "Bus Transportation," provision is made for the standardization of bumpers heights. This is a step in the right direction.

Building Managers Visit Bureau.—A group of New York building owners and managers, all members of the Building Managers and Owners Association of New York City, were guests of the Bureau of Standards on April 22. Following a conference with officials of the bureau, the visitors were given the opportunity to inspect the work being carried on in the several laboratories.

The inspection trip included a review of the testing of brick walls; a new equalizer for elevator cables; the elevator interlock and safety appliance tests; the large testing machines, one of which for high-precision work has a capacity of 1,150,000 pounds in tension and 2,300,000 in compression, and another, the largest in the world, with a capacity of 10,000,000 pounds in compression. The visitors also saw the 56-inch wind tunnel in which can be developed a maximum velocity of 75 miles per hour for use in studies of wind pressure on structures, and the sound chamber in which tests are conducted on partition walls of varying composition for their sound-transmissive properties.

Engineers, technicians, and scientists, when visiting Washington, are always welcome at the bureau. Business men often find in the work going on there information helpful to them in researches connected with improvement in their products and the processes by which they are made. A general trip through the laboratories is arranged daily for visitors, starting at 2.15 p. m. from Room 302, South Building.

NEW PUBLICATIONS

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1927).

Scientific Papers[1]

S571. Unusual features in the microstructure of ferrite; H. S. Rawdon and T. Berglund. Price, 35 cents.

Technologic Papers[1]

T364. Tensile properties of soft rubber compounds at temperatures ranging from −70° to +147° C.; R. F. Tener, S. S. Kingsbury, and W. L. Holt. Price, 10 cents.

T366. Strength of interlocking-rib tile walls; A. H. Stang, D. E. Parsons, and A. B. McDaniel. Price, 10 cents.

T367. Effect of the testing method on the determination of corrosion resistance; H. S. Rawdon and E. C. Groesbeck. Price, 20 cents.

Circulars[1]

C319 (3d ed.). Alphabetical index and numerical list of United States Government master specifications, promulgated by the Federal Specifications Board. Free on application to the Bureau of Standards.

C333 (2d ed.). Specifications for the manufacture and installation of two-section, knife-edge railroad track scales. Price, 10 cents.

Simplified Practice Recommendations[1] (Elimination of Waste)

R75. Composition blackboard. Price, 5 cents.

Technical News Bulletin[1]

TNB133. Technical News Bulletin, May, 1928.

OUTSIDE PUBLICATIONS[2]

Report of the chairman of the commission on radio wave propagation, International Union of Scientific Radio Telegraphy. L. W. Austin; Proceedings, Institute of Radio Engineers (New York, N. Y.), p. 348; March, 1928.

---

[1] Send orders for publications under this heading, with remittance, only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscriptions to Technical News Bulletin, 25 cents per year United States, Canada, and Mexico); 40 cents (foreign).

[2] "Outside publications" are not for distribution or sale by the Government. Request should be sent direct to publishers.

Specification for dental gold alloys. W. Souder; Journal, American Dental Association (Chicago, Ill.), Vol. 15, No. 4, 627; April, 1928.

Results of two recent detonation surveys. H. K. Cummings; Journal, Society of Automotive Engineers (New York, N. Y.), Vol. XXII, No. 4, p. 448; April, 1928.

Volatility data from gasoline distillation curves. Oscar C. Bridgeman; Journal, Society of Automotive Engineers (New York, N. Y.), Vol. XXII, No. 4, p. 437; April, 1928.

Matches, fire hazard tests. P. D. Sale; Quarterly of the National Fire Protection Association (Boston, Mass.), Vol. 21, No. 4, p. 331; April, 1928.

Color sensitivity. I. G. Priest; Oil and Fat Industries (J. C. P. Helm, 705 Tchoupitoulas Street, New Orleans, La.), Vol. V, No. 3, p. 63; March, 1928.

Spectral characteristics of light sources and window materials used in therapy. W. W. Coblentz; Transactions of the Illuminating Engineering Society (New York, N. Y.), Vol. XXIII, No. 3, p. 247; March, 1928.

Cautions regarding gas appliance attachments. J. H. Eiseman; American Gas Journal (New York, N. Y.), Vol. 128; p. 32; April, 1928.

The elevator of to-morrow. John A. Dickinson; National Safety News (Chicago, Ill.), Vol. XVII, No. 5, p. 25; May, 1928.

Standard atmosphere. W. G. Brombacher; Lefax (Philadelphia, Pa.), Dewey classification 533.6: Lefax O; March, 1928.

Increasing the capacity of the Elmendorf tearing tester. F. T. Carson and L. W. Snyder; Paper Trade Journal (New York, N. Y.), Vol. 86, No. 13, p. 57; March 29, 1928.

A study of the Thwing impact tester. H. C. Eckhardt and L. W. Snyder; Paper Trade Journal (New York, N. Y.), Vol. 86, No. 15, p. 64; April 12, 1928.

Corrosion embrittlement of duralumin. I. Practical aspects of the problem. H. S. Rawdon; National Advisory Committee for Aeronautics (Washington, D. C.), Technical Note No. 282; April, 1928.

Corrosion embrittlement of duralumin. II. Accelerated corrosion tests and the behavior of high-strength aluminum alloys of different compositions. H. S. Rawdon; National Advisory Committee for Aeronautics (Washington, D. C.), Technical Note 283; April, 1928.

Corrosion embrittlement of duralumin. III. Effect of the previous treatment of sheet material on the susceptibility of this type of corrosion. H. S. Rawdon; National Advisory Committee for Aeronautics (Washington, D. C.), Technical Note No. 284; April, 1928.

Report on test of Stevenson Creek dam. W. A. Slater; Proceedings, American Society of Civil Engineers (New York, N. Y.), Vol. 1, Part 3, p. 49; May, 1928.

An improved coordinator. R. A. Castleman, jr.; Journal, Optical Society of America and Review of Scientific Instruments (Ithaca, N. Y.), Vol. 16, No. 4, p. 287; April, 1928.

Problems of research. Address before the American Association of Dental Schools, March 27, 1928. George K. Burgess; Oral Hygiene (1117 Wolfendale Street, N. S. Pittsburgh, Pa.), p. 872–G; May, 1928.

The following articles were published in the series on "Practices and Standards," in the United States Daily (Washington, D. C.):

F. S. Holbrook:

Uniformity of weights and measures standards; April 6.

Tests of railway and mine scales; April 7.

Frederick Bates:

Sugar standards research, April 9.

Research on levulose and dextrose; April 10.

George K. Burgess:

Relation of research to specifications; April 11.

U. S. GOVERNMENT PRINTING OFFICE: 1928